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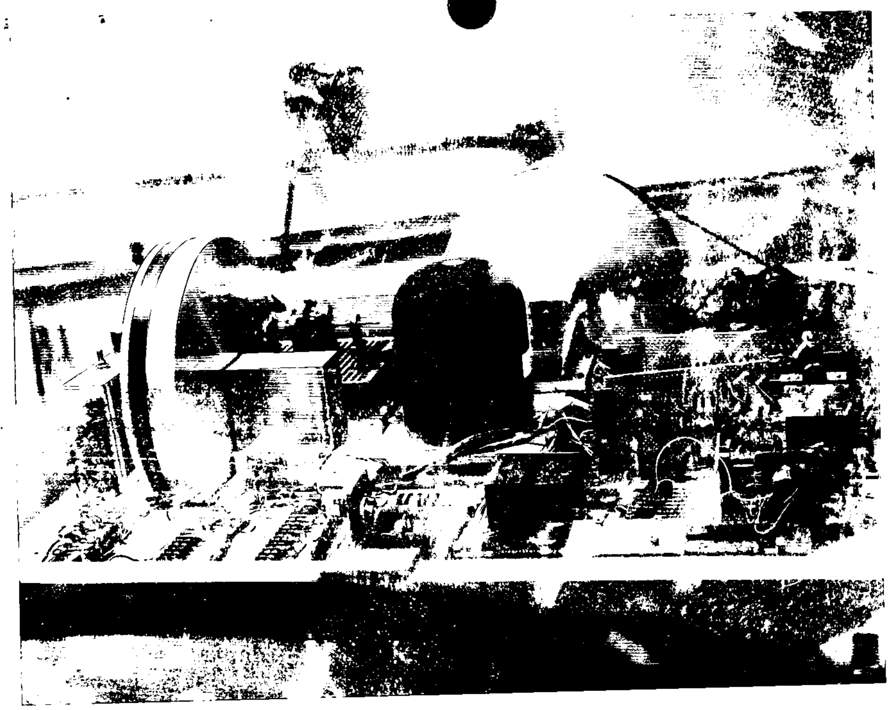
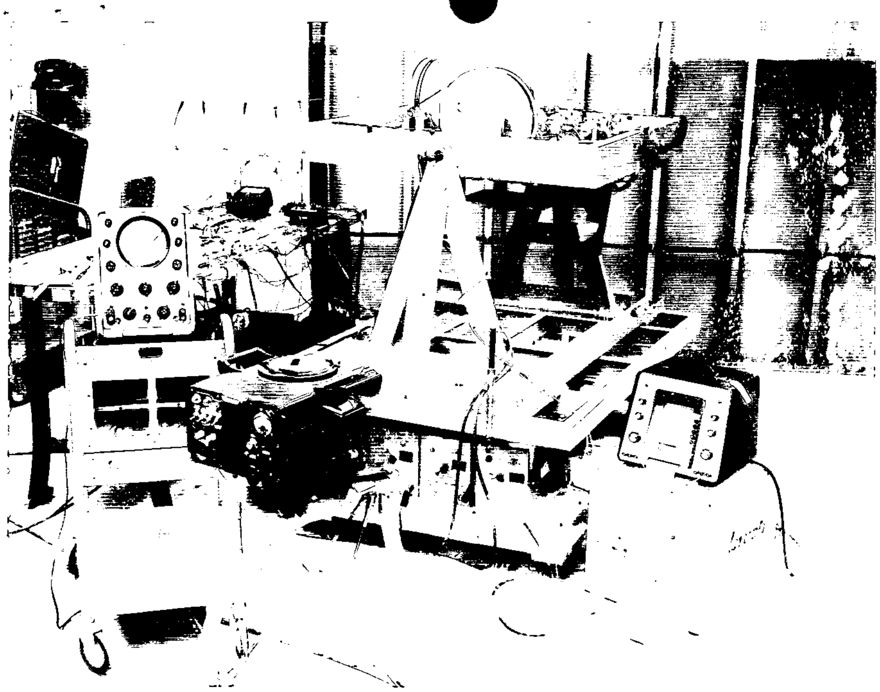
Approved For Release 2001/03/22 : CIA-RDP67B00511R000100160023-9





Another stabilization system previously breadboarded and tested by Perkin-Elmer is shown in the illustration below. In this particular application it was necessary to stabilize the system within $\pm 15'$ of arc in one horizontal axis (latitude), and $\pm 30'$ of arc in a perpendicular axis (longitude). Steadiness requirements imposed were approximately 1/4 of an arc second. The ultimate in rigidity was essential and minimum weight was a mandatory requirement.

This particular system was stabilized about the two axes by weight shifters. Rather than use dead weights, the weights themselves were electronic assemblies and components. The high frequency response necessary to negate internally induced disturbances was provided by torquing the platform against inertial space. This was accomplished by a torque motor and flywheel mounted on the platform with spin axis parallel to the control axis.

The error sensing elements were separated into pointing and steadiness regions. The pointing signals were derived externally and were used to position a polaroid mirror such that the plane of the mirror face was parallel to the true gravity vector and normal to the longitudinal axis. The polarizing direction was fixed and oriented with respect to the gravity vector to establish the latitudinal axis reference. The mirror was tracked optically by a scanner on the platform, thereby producing pointing signals for platform control. The steadiness sensors were very high sensitivity rate gyros.

The amplifier gains were chosen on the basis of computer studies. Unfortunately, the noise output of the gyro prevented raising the amplifier gain levels to the optimum values. This resulted in a bandpass of about 1.0 c.p.s. instead of the 10 c.p.s. desired.

The entire breadboard assembly was mounted on a 3-axis rocking table as shown in the figure below. The amplitudes and frequencies of normally anticipated disturbing motions were simulated, and measurements were made at frequencies both higher and lower than these anticipated disturbances.

The Brush recorder strips in the associated illustration show part of a test run with the longitudinal axis only. The alignment theodolite showed peak-to-peak platform motions of less than 7.0 arc sec. The thickening of the pen line was caused by gyro noise with a magnitude in the order of 10.0 arc sec. It can be seen that the platform error was a sinuosoid at rocking frequency, with a peak-to-peak amplitude approximately equal to the 7.0 arc sec. (measured optically). This represents a platform angular velocity much less than the design objective. Note that a three inch-pound transient disturbance produced no noticeable error increase.

Simultaneous operation of both axes is represented by the recorder strip below. The latitudinal axis shows larger excursions than longitudinal because the gain on that channel was reduced to examine the effect of gain on error. During these measurements, the platform was oscillated in the third axis, and no cross-coupling was observed. The predictions of the computer program - that the servo control loops were stable - were confirmed by these experiments.

Had this platform utilized a more sensitive rate gyro, such as are now becoming available (with deflection sensitivities equivalent to 0.1 arc second over a bandpass of 30 c.p.s.), it could have been stabilized to overcome internally generated disturbances up to about 10 c.p.s.

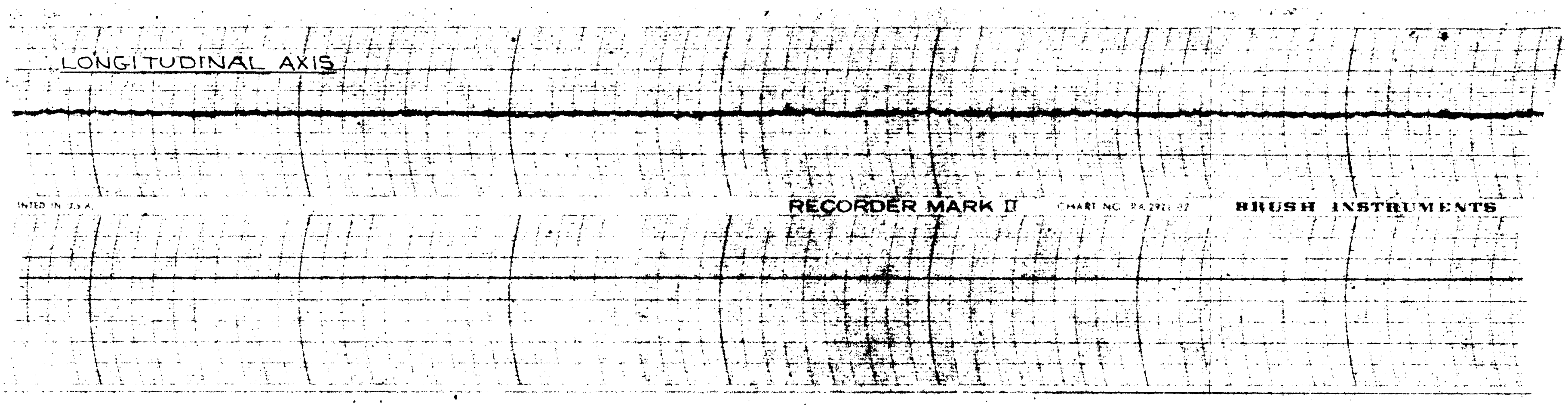


TABLE PERIOD= 5 SEC./CYCLE TAPE SPEED= 1MM/SEC. SCALE= 10ARC SEC./MM

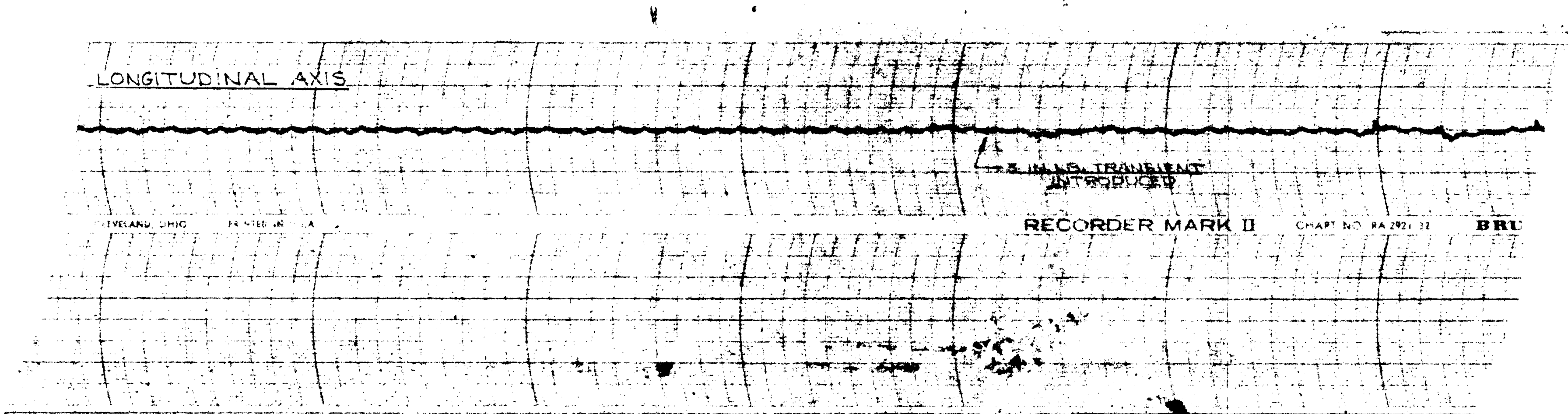


TABLE PERIOD=5SEC./CYCLE TAPE SPEED= 1MM/SEC. SCALE = 10 ARC SEC./MM

GYRO ERROR SIGNAL- LONGITUDINAL AXIS ONLY

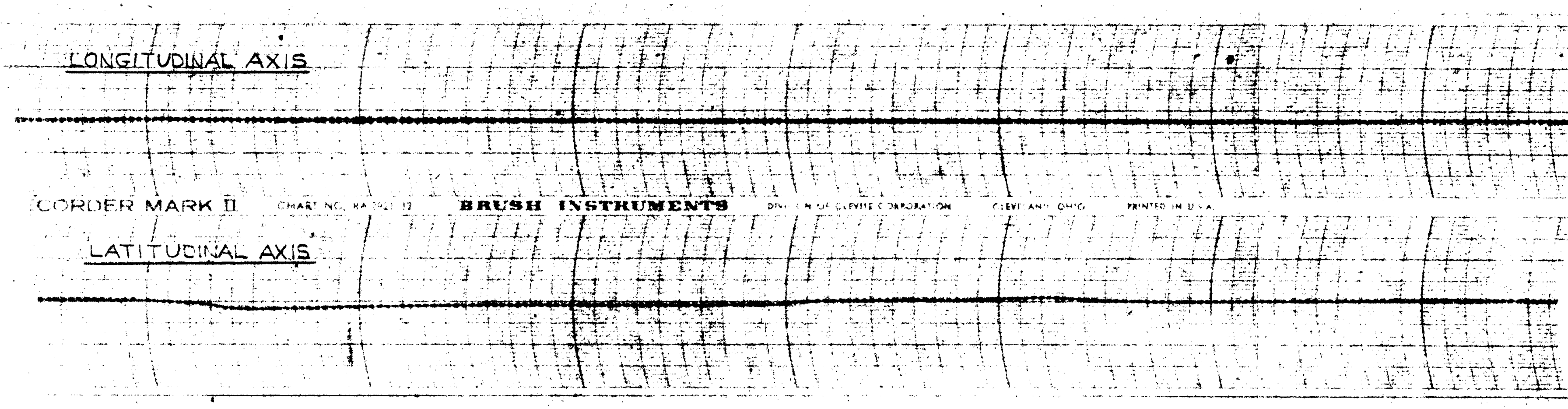


TABLE PERIOD: BOTH AXES = APPROX. 6 MIN./CYCLE TAPE SPEED = 1 MM/SEC. SCALE = 10 ARC SEC./MM

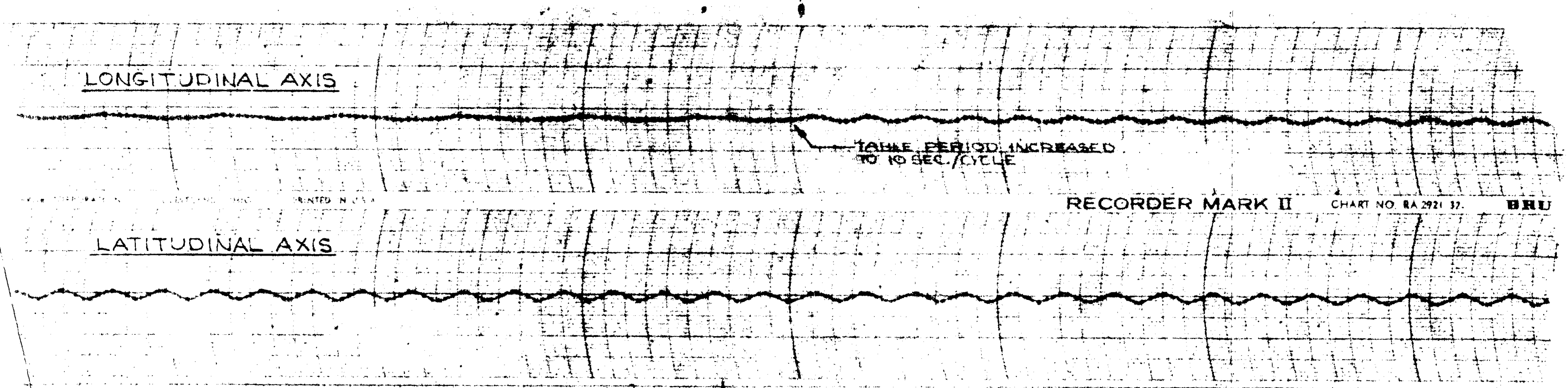


TABLE PERIOD: LONGITUDINAL AXIS = 25 SEC./CYCLE TAPE SPEED = 1 MM/SEC. SCALE = 10 ARC SEC./MM
LATITUDINAL AXIS = 12 SEC./CYCLE

GYRO ERROR SIGNAL - BOTH AXES